Estimating Mean Ocular Perfusion Pressure Using Mean Arterial Pressure and Intraocular Pressure

According to Ohm's law, blood flow through a circulation is governed by the ratio of the arteriovenous pressure gradient to the vascular resistance. In the retinal circulation, the arteriovenous pressure gradient (or mean ocular perfusion pressure, MOPP) is equal to the difference between the pressure in the central retinal artery (CRA) and the central retinal vein (CRV). To prevent retinal veins from collapsing under the transmural force exerted by the intraocular pressure (IOP), the pressure inside retinal veins should exceed the IOP (the so-called Starling resistor effect).[1] Because of this equilibrium, IOP closely approximates the pressure inside the CRV under physiological conditions.[2,3] Similarly, CRA pressure can be measured indirectly using an ophthalmodynamometer, by quantifying the amount of external pressure needed for retinal arteries to collapse.[4] Because of the inconvenience of ophthalmodynamometry, CRA pressure is often estimated based on the mean brachial artery blood pressure (MAP):

$$\mathrm{MAP} = \frac{1}{3} \times \mathrm{SBP} + \frac{2}{3} \times \mathrm{DBP}$$

where SBP and DBP represent systolic and diastolic brachial artery pressures, respectively.

Depending on body position, different correction factors have been used to account for the difference between brachial and ocular blood pressures, which exists due to differences in flow resistance and hydrostatic pressure between the arm and the eye.[5] For humans in a seated position, two-thirds is a commonly accepted correction factor to estimate CRA pressure based on brachial blood pressure.[6] Therefore, MOPP can be calculated using the formula:

$$\mathrm{MOPP}_{\mathrm{correct}} = \frac{2}{3} \times \mathrm{MAP} - \mathrm{IOP}$$

However, a literature review of all articles on MOPP, published in this journal from 1981 to 2016, reveals that several papers erroneously used/reported the formula[7–14]:

$$\mathrm{MOPP}_{\mathrm{incorrect}} = \frac{2}{3} \times (\mathrm{MAP} - \mathrm{IOP})$$

Since multiplication takes precedence over subtraction, the latter formula results in an overestimation of MOPP in the range of 5% to 25% in a normal population.[15,16] This could lead to erroneous conclusions when comparing results across studies. Therefore, to ensure uniformity and comparability between studies, care should be taken to use and report the correct formula when estimating MOPP based on MAP and IOP.

Karel Van Keer[1]
João Barbosa Breda[2]
Luís Abegão Pinto[3]
Ingeborg Stalmans[1,4]
Evelien Vandewalle[1]

[1]Department of Ophthalmology, University Hospitals Leuven, Leuven, Belgium; [2]Department of Ophthalmology, Centro Hospitalar São João, Porto, Portugal; [3]Department of Ophthalmology, Centro Hospitalar Lisboa Norte, Lisbon, Portugal; and the [4]Department of Ophthalmology Neurosciences, Laboratory of Ophthalmology, KU Leuven, Leuven, Belgium.
E-mail: Evelien.vandewalle@uzleuven.be

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